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Federal Communications Commission
Office of the Secretary

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of:

Telocator Petition for	)	
Rulemaking to Amend Part 22 of	)	
the Commission's Rules Concerning	)	RM - 7617
the Use of 930-931 MHz for an	)	
Advanced Messaging Service	)	

Motorola Inc. ("Motorola") is pleased to submit its comments in the above-captioned rulemaking.

Respectfully submitted,

Leonard S. Kolsky
Vice President & Director
Regulatory Affairs
Government Relations
Motorola Inc.
1350 I Street, N.W., Suite 400
Washington, DC 20005
(202)371-6932

Michael A. Menius
Attorney
Government Relations
Motorola Inc.
1350 I Street, N.W., Suite 400
Washington, DC 20005
(202)371-6937

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EXECUTIVE SUMMARY

Motorola supports the petition to make the 930-931 MHz band available for use by Advanced Messaging Services (AMS). These services, as described by Telocator, are the logical extension of paging and are greatly needed by the public. A discussion of many of these technologies is provided below.

This spectrum is needed now. The technology exists to begin certain AMS services. The Motorola EMBARC system will be an early example. The technology for other services is forthcoming, as discussed below.

The 930-931 MHz band provides a vital platform for the early growth of AMS services. This spectrum is ideal for AMS because it is between two currently allocated paging bands and is below 1 GHz, which helps to ensure that as AMS is developed it remains, like its paging counterpart, the "lowest cost service," an essential attribute of one-way messaging services.

Current paging spectrum is not suitable to overlay AMS, because users would experience the passing on of increased operational costs over conventional paging service (which will still be demanded); moreover, the change-out costs would be prohibitively high. Prudent system operators would recognize the impossibility of passing on such high cost increments to the public and would reject the transition to AMS on current channels.

The United States must not lose its lead in future wireless telecommunications systems, including the AMS applications. The 930-931 MHz spectrum provides the means to begin new and important one-way messaging services. These same services, if not developed domestically, will assuredly be implemented from other countries which have already begun taking similar developmental steps. The Commission must enable this country to retain this lead by permitting the rapid implementation of such services within the very spectrum which it had wisely placed in reserve for paging.

INTRODUCTION

The petition to make the 930-931 MHz spectrum available for Advanced Messaging Service is based upon the public's demand for technological innovations to meet their expanding needs for one-way messaging services. Paging has been a dramatic success. The public's acceptance of paging has contributed greatly to the nation's productivity as well as to the quality of people's lives.

The Commission wisely allocated spectrum in various bands including 900 MHz for this service. It prudently retained the 930-931 MHz band in reserve for new (paging) technologies. The success story of paging has now led to the nest step: technological advances that will bring paging service into the 1990's, 2000, and beyond. These advances are more than an attractive option: they are essential if the United States is to retain its leadership in this arena. They are also essential to meet the public's demands for spectrum efficient communications services.

I. AMS TECHNOLOGY IS AVAILABLE FOR IMPLEMENTATION.

Some of the exciting forms of Advanced Messaging Services are discussed at this point. As stated earlier, the technology exists to make these services a reality. What is needed is the appropriate spectrum commitment, as requested in the Petition.

Portable Computers and E-Mail

Portable computers are providing means for greater untethering from the office. Recent marketing studies indicate approximately 1 million laptop computers, "notebook" computers, plus handheld portable computers were in service at the end of 1989, with about 3.5 million projected for 1992. Market growth for this period is thus projected to occur at an explosive 50% per year.[1]

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[1] Figures provided by marketing firm Dataquest. See graphic depiction in Figure 1, which uses these Dataquest fiqures and further extrapolates these trends into the year 2000.

The U.S. Electronic Mail market includes over 8 million users (private and public) with revenues of over $500 million and recent growth exceeding 40% per year. Forecasted 5 year growth rates for the E-Mail market are approximately 35% per year.

The intersection of the portable computer devices markets with the E-mail markets provides a high growth opportunity for radio E-mail messaging. We expect the market for laptop computers with one-way RF receptor modems to be about 180,000 in 1992, growing to over 8 million by the end of the decade. These projections are shown in Figure 1. Similar quantities are expected for palmtop computers, personal organizers and other small devices capable of receiving one-way messages. An expectation of the total one-way RF messaging E-mail device market is show in Figure 2, reaching almost 16 million units by the end of the decade.

Traffic to these units is expected to consist largely of short, 250-500 character E-notes. The daily E-note traffic during the business hours is estimated to be on the order of 1,000 characters as compared to the 100-120 characters received by a typical alphanumeric pager. Using the relatively new 1,200 BPS paging technology, slightly over 3,000 E-mail users could be put into service per channel appearance with the expected traffic rates. Within 2 years, new paging, technology will allow an increase of the throughput per channel by a factor of 4 or 5, yielding 12,000 or more E-mail users per channel appearance at the expected usage rates.

Motorola's new EMBARC system, scheduled to be offering E-note service in many areas this year, and every major U.S. SMSA within a few years, is an indication of our belief in the future of one-way transmission to portable computer devices. It will adopt the new high speed signalling methods as soon as they are available.

Voice Messaging

The emergence of voice messaging services is related to a combination of technology considerations and system economics, which are discussed below. The important point is that

LAPTOP + NOTEBOOK + HANDHELD PORTABLE COMPUTERS IN SERVICE

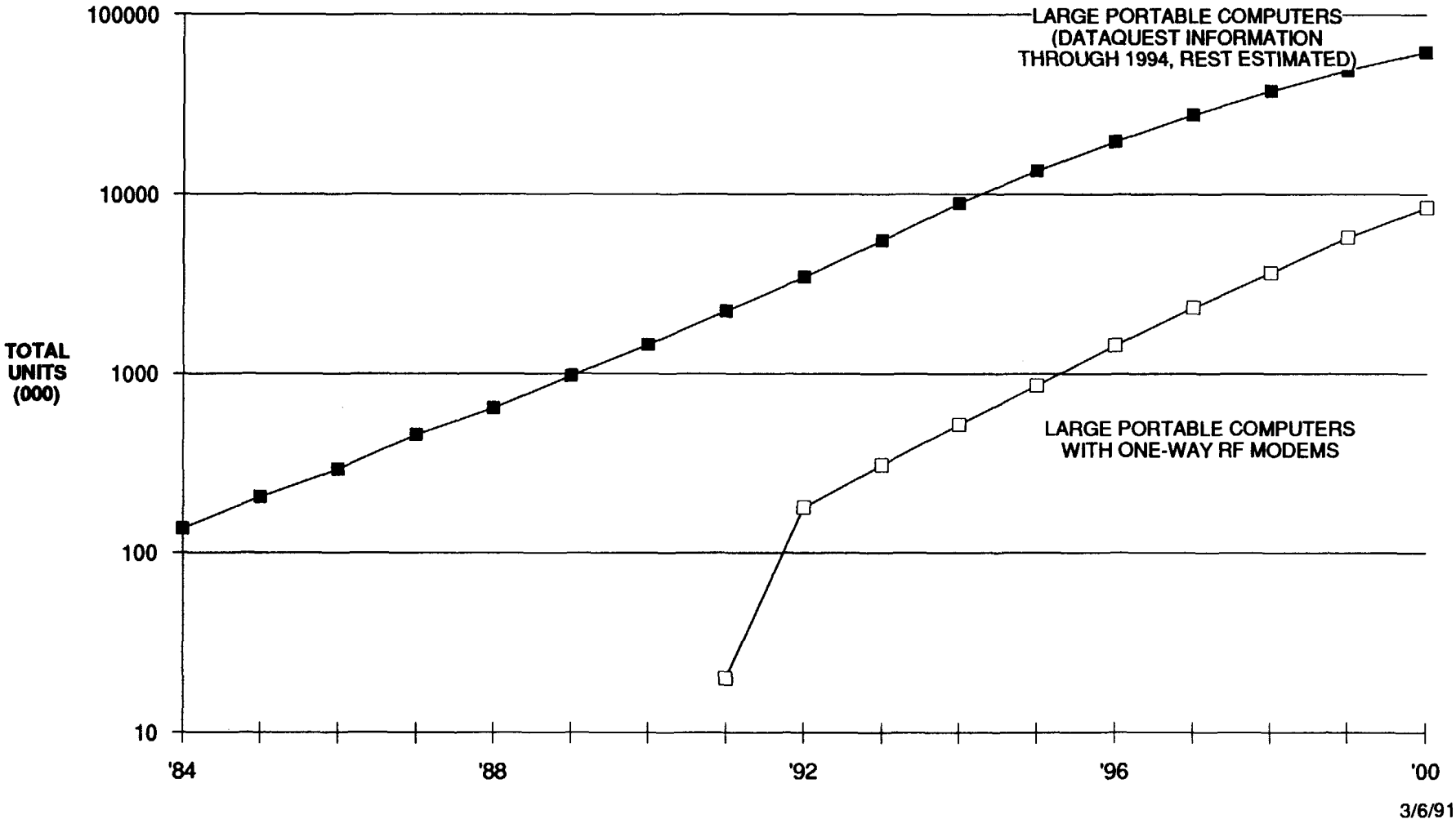

FIGURE 1

PAGING SPECTRUM NEEDS
NEW SERVICES SCENARIO - PAGER TYPES

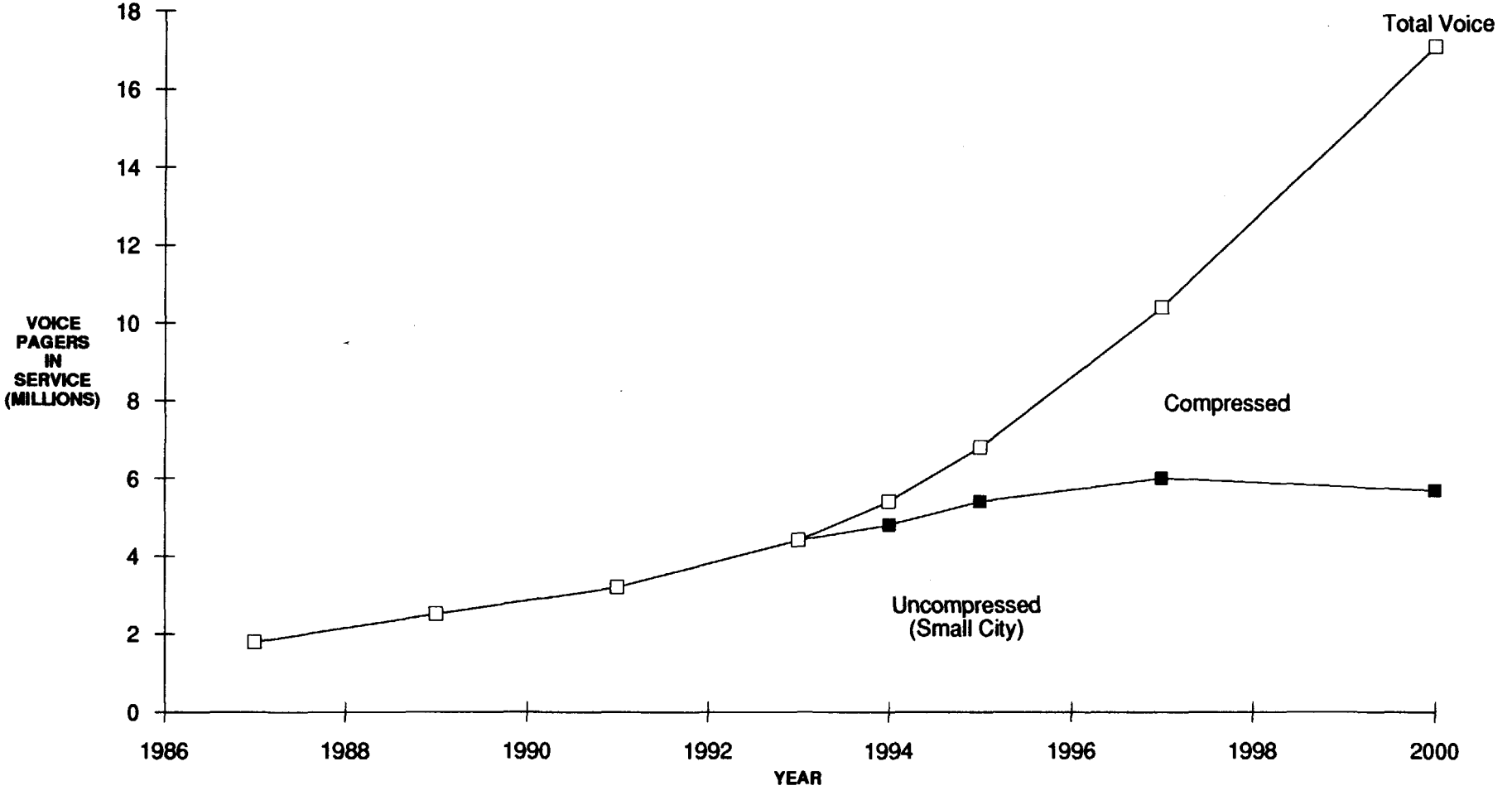

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FIGURE 2

the marketplace has now evolved to the point where it is feasible to add voice messaging capabilities to the menu of AMS features. Additional pager complexities will have to be implemented so that voice compression is included in AMS configurations. These developmental steppingstones, however, are within reach and are well within the current scheme of technology advances.

Voice paging services have always offered the favorable combination of an entry means as simple as a telephone answering machine with a message that can carry sufficient information to alleviate follow-up phone calls. However, as Telocator correctly stated in its Petition, the initial offerings "suffered from two defects related to real time operating constraints which severely compromised its utility - - inconvenient broadcast times and the inability to replay messages." New pager offerings currently solve these issues by allowing the electronic recording of the page message within the portable unit for replay when desired, where desired, as often as desired, and at the desired listening level.

With the user issues solved as above, an additional issue that must be addressed has to do with system economics for the large city. A typical semi-real-time voice paging system can usually accommodate no more than approximately 1,500 users per channel appearance. This number of users may be very high by typical two-way channel references, but is small by coverage, the approximately 1,500 voice paging users can provide service fees sufficient to pay for the costs of coverage plus all other system associated costs. In large cities where many transmitters are required, the cost of coverage can be prohibitive when such a small user population is served.

Voice compression techniques, similar to those which have been demonstrated for various radio services, can be applied to paging. Such techniques will multiply the number of users to spread the burden of the cost of each transmitter, thus improving system economics.

The viability of sufficient and acceptable paging system compression capability is dependent upon the capability of reconstruction in the pager. Figure 3 shows the degrees of pager complexity, measured in equivalent gates, which have been achieved over the last 2 1/2 decades while staying within the cost, battery life and size restraints of pager receivers. The

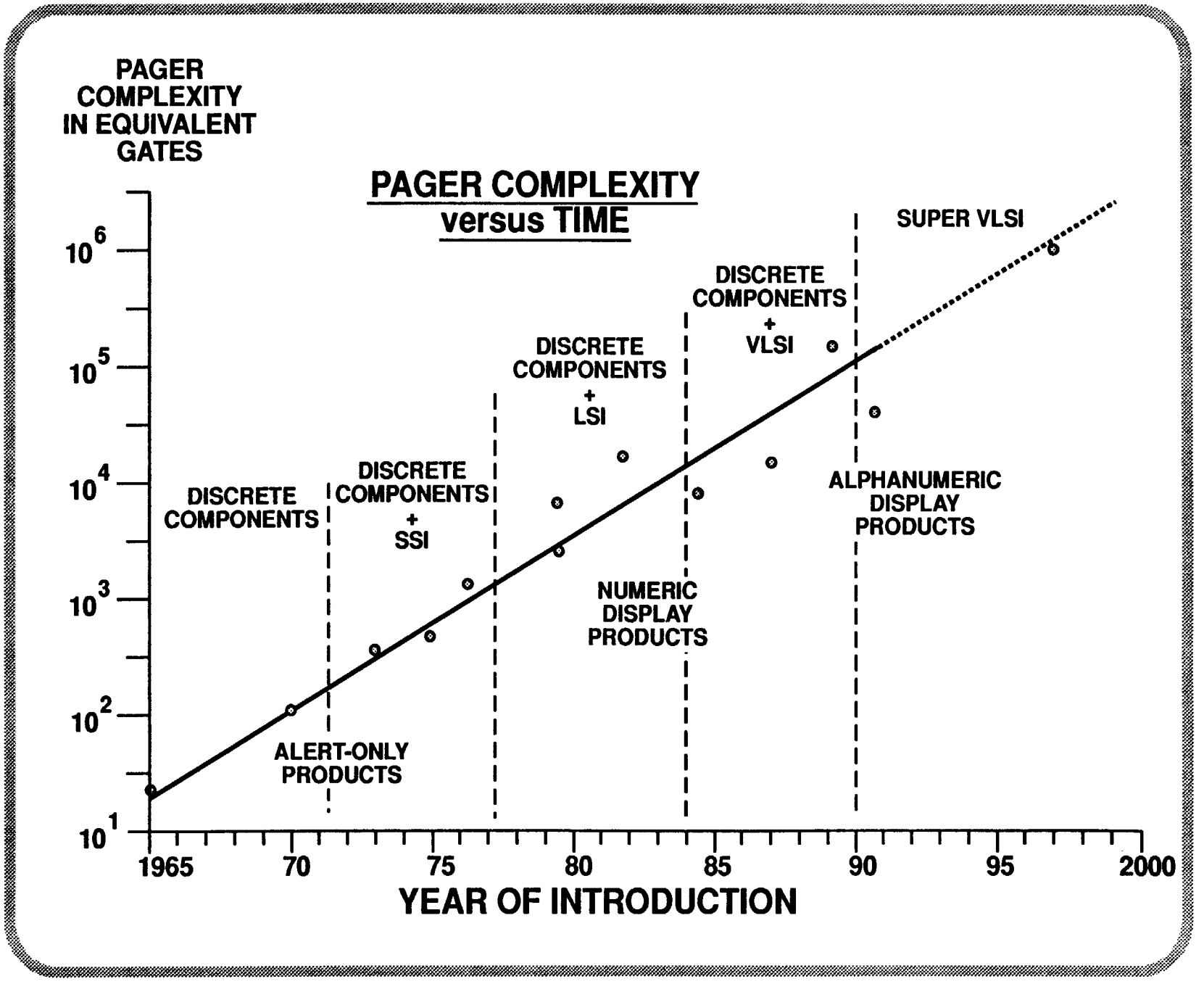
PAGER COMPLEXITY IN EQUIVALENT GATES
PAGER COMPLEXITY
versus TIME
SUPER VLSI
DISCRETE COMPONENTS + VLSI
DISCRETE COMPONENTS + LSI
DISCRETE COMPONENTS + SSI
DISCRETE COMPONENTS
ALPHANUMERIC DISPLAY PRODUCTS
NUMERIC DISPLAY PRODUCTS
ALERT-ONLY PRODUCTS
10^6
10^5
10^4
10^3
10^2
10^1
1965
70
75
80
85
90
95
2000
YEAR OF INTRODUCTION

FIGURE 3

first alphanumeric pagers were introduced in 1983, using slightly more than 10,000 equivalent gates. The marketplace is now capable of implementing more than one order of magnitude greater pager complexity, sufficient to implement many of the Advanced Messaging Service features, such as voice compression.

Graphics

The Telocator petition has pointed out the growth in the FAX market. This is another area where we are seeing the intersection of two growth curves, one for FAX transmissions and the other for mobile communications, particularly where portable computers are involved. We expect the initial market for one-way FAX to be similar to the E-mail market in that the recipient will be a portable computer. Graphics (even short FAX messages) involves the transmission of a relatively large number of information bits, so the acceptance and growth of FAX graphics is keyed to higher throughput of data, spectrum availability, and airtime cost containment. One way that these factors will be resolved is through the small graphics displays, probably on pocket FAX receptors. These smaller, more portable receptors will be more convenient for the user and will make the cost more attractive as well. As these products thus become more practical, their acceptance will increase, and AMS will become a one-stop shop for advanced one-way messaging services.

II. 930-931 MHz IS NEEDED NOW AND WILL BE FULLY OCCUPIED IN THE NEAR TERM.

The demand for, and the growth of the extended paging market (including Advanced Messaging Services) is not a trend of the future but is happening now and will continue in the coming decade and beyond. Figure 4 illustrates this projected growth. Total tone, numeric and Alpha voice products are expected to exceed 40 million units in service. This figure includes not only conventional paging technology; the voice units also include (in the large cities) voice products of the AMS compressed voice type.[2] In addition to the 40 million units, additional

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[2] This total is consistent with world paging estimates by World Mobile Communication. See Volume 1, Number 10, June 27, 1990, edition, page 2.

PAGING AND ADVANCED MESSAGING SERVICES
PROJECTED GROWTH

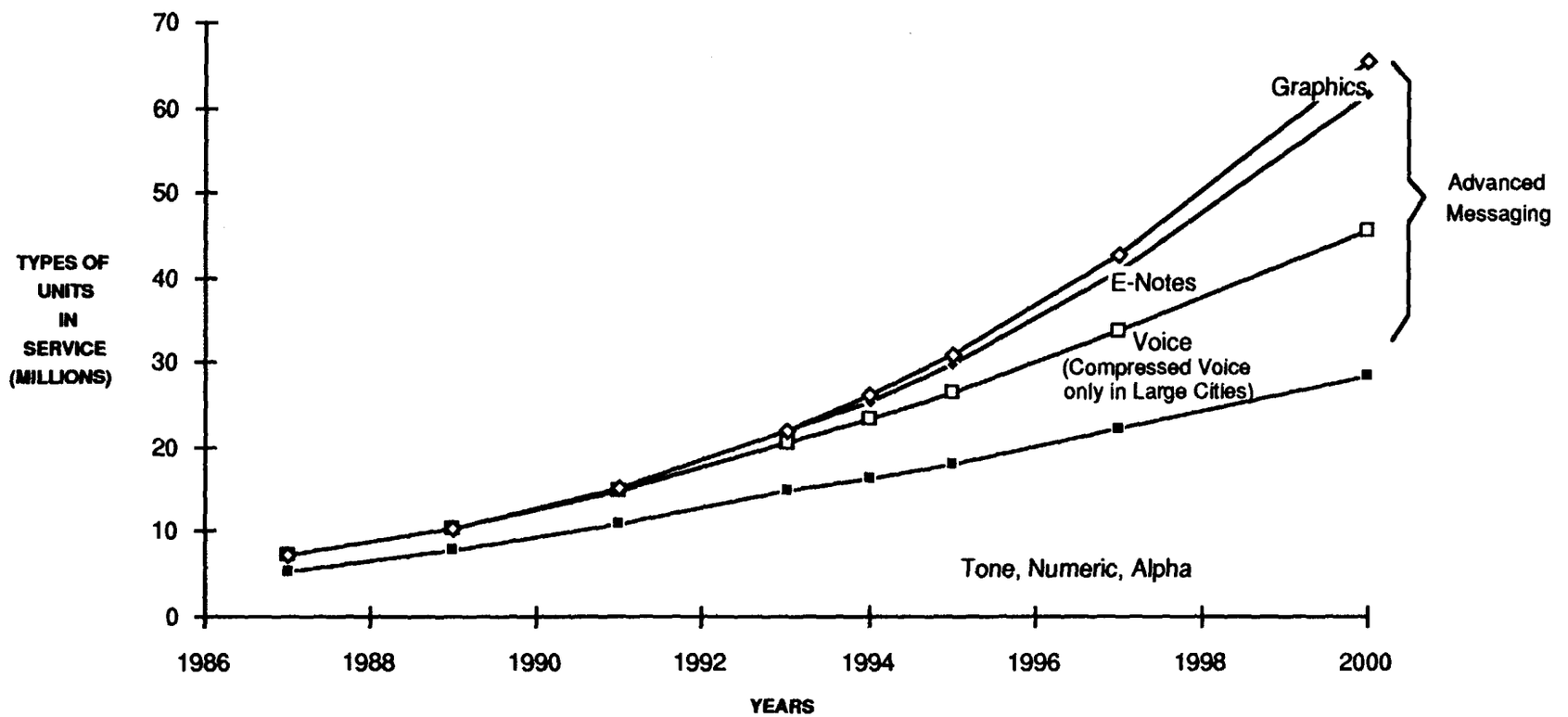

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FIGURE 4

users which receive graphics and will use computers which receive E-notes. These users are projected to increase the total user base by approximately 20 million.

The usage figures provided below demonstrate that these future applications will be spectrally efficient. Even though more airtime is consumed than by conventional paging messages, greater data throughput rates, compression techniques, and other advances will permit an excellent level of users per "channel appearance." For comparison's sake, figures are provided for uncompressed voice technology.

Typical 1990 Service	Approximate number of Users Per 25 kHz Channel Appearance
Uncompressed Voice (small city)	less than 1,500
E-Notes (more than 4800 BPS)	more than 12,000
Compressed Voice (more than 8 times)	more than 12,000
Graphics (more than 4 sec/day - busy hours)	up to 8,000

The channel capabilities are thus impressive. It is clear that channels allocated to AMS will not be efficiently used. Figure 5 makes projections of the demand across the country, for three forms of AMS (E-notes, voice messaging, and graphics). This demand is projected for the very near term (year 1995) and also into 2000. The chart shows that the 930-931 MHz band will indeed be a very meager allocation of spectrum: by the mid-90's, the spectrum will already be inadequate to meet the projected needs in the largest cities.[3] Even more compelling is the projection into 2000, which shows that this will be the case in cities all over the country!

It is clear that the 930-931 MHz allocation is a very conservative allocation which is urgently needed to launch AMS, but which will not suffice to meet the users' long-term needs for AMS. These latter needs will necessarily be met elsewhere and will doubtless be the subject of other proceedings beyond the scope of this proceeding. It is important, however, to recognize

[3] The 930-931 MHz band can, for these purposes, be viewed in terms of 40 "equivalent channels" of 25 KHz, even though it is well understood that channel splitting and other technologies may alter the actual channel configuration.

EQUIVALENT CHANNELS: BIG CITIES
FOR ALL ADVANCED MESSAGING SERVICES

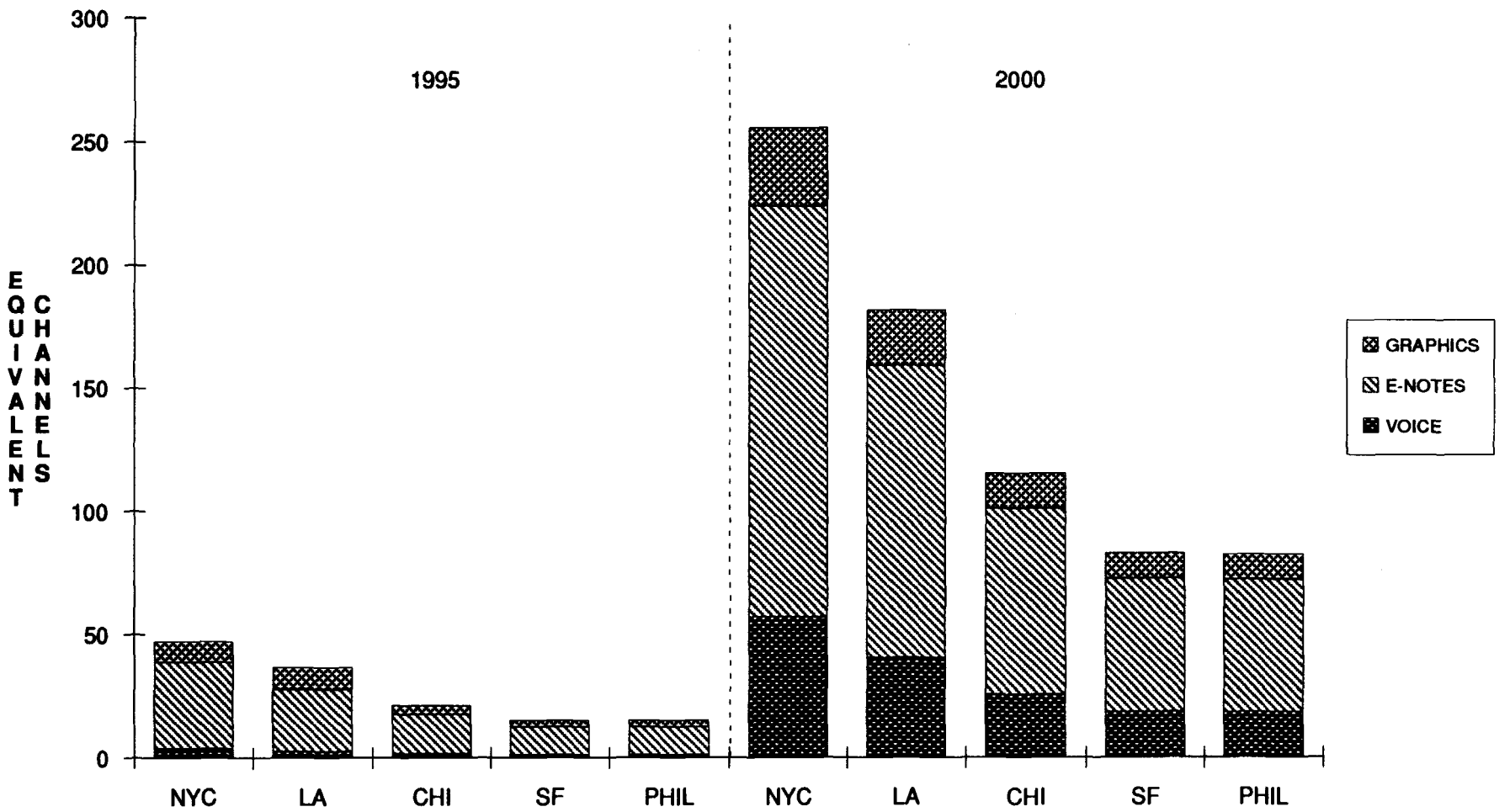

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FIGURE 5

the essential role of this particular portion of the spectrum in the early implementation of AMS. That issue is addressed at this point.

III. THE 930-931 MHz BAND IS A UNIQUE AND VITAL KEY TO AMS IMPLEMENTATION

The 930-931 MHz band, by its location, provides an essential "spectrum platform" to launch the panoply of Advanced Messaging Services in this country. The band is positioned between two currently allocated paging bands. As such, it greatly facilitates the rapid of products and services by saving both time and money which must be devoted to research and development. The Motorola EMBARC technology, for example, has been developed initially for operation within the 931 MHz band. Future E-note applications will lend themselves readily to implementation within the petitioned spectrum.

A second important factor is the real-world consideration that equipment operating on spectrum below 1 GHz will be less costly than that designed for higher bands. Although AMS will in all likelihood have to seek additional spectrum in the future above 1 GHz, it is essential that at its developmental stages, AMS remain, like its paging counterpart, as the "lowest cost service." If, at its conceptual stages, AMS is forced into significantly higher cost brackets because of higher frequency cost penalties, there is a serious question as to whether paging users will embrace these advances in messaging technology. This spectrum is needed today for the development of technologies, at affordable prices, technologies which can then be passed on to higher bands when costs will have been reduced by the public's expanded use.

IV. CURRENT PAGING SPECTRUM IS NOT SUITABLE TO OVERLAY AMS

Current paging systems employ unique technology, unlike cellular or other two-way mobile messaging systems, which make them unsuitable for introduction of Advanced Messaging Services (as described above) onto existing paging channels.

Paging systems are designed to serve a high number, frequently thousands, of users. By contrast, most two-way voice systems serve perhaps 25 to 100 users per transmitter. In

order to ensure reliable coverage, additional transmitters are typically installed for both types of systems, but in the case of paging systems, the requisite number of additional transmitters may be significantly higher.

Paging systems are designed to provide very short, highly reliable, tone, numeric or alphanumeric messages to thousands or tens of thousands of users per channel appearance. A well designed system will have greater than 90% probability of reception on the first floor of urban buildings and much greater than 99.99% probability of reception on the adjoining streets. In order to provide this quality of coverage, a number of transmitters are used in a simulcast mode, providing a form of both diversity and reinforcement. Even though these installation costs are high, they are cost effective, in view of the very large number of users served. If, on the other hand, system operators were to attempt to overlay AMS on their paging systems, a very different picture would emerge, both in terms of cost and service quality.

Most current U.S. paging systems operate at bit rates of 512 to 600 BPS, with some at 1200 BPS recently coming into operation. With these bit rates, the pagers will still operate properly when the signals are transmitted with time offsets of 100 microseconds or more.

New signalling schemes expected for AMS may become an important factor in the proper reception of paging messages. Advanced messaging systems are expected to operate at a multiple of four or more times the bit rate of 1200 BPS POCSAG. With these higher bit rates, the air propagation delay differentials from the transmitters will leave only a few microseconds tolerance for transmission differentials. Additional variances from current paging systems may be caused by new modulation methods, new design strategies, closer sites, and other factors associated with higher speed AMS signalling technology.

In many cases, the system changes to implement AMS technology would be so drastic that prudent system operators would understandably decline to modify existing paging systems. They would correctly foresee an increase in the cost of delivered air time to current paging users. Accordingly, currently allocated paging spectrum is not a suitable home for the launch of the Advanced Messaging Services which are needed. Conversely, the 930-931 MHz band, because of

its proximity to the spectrum where current technology is utilized, is the ideal location for AMS.

V. THE U.S. IS A WORLD LEADER IN PAGING AND MUST NOT LOSE ITS LEADERSHIP IN ADVANCED MESSAGING SERVICES.

The U. S. currently has the most diverse offering of paging in the world with tens of thousands of private systems, hundreds of paging carriers, numerous nationwide networks using land mobile frequencies and FM Broadcast Subcarriers. Roughly 40% of the world's subscriber pagers are consumed in the United States, and over 50% are sourced by U.S. manufacturers. It is important to our nation's economic interests that this lead be maintained.

Even if the Commission does nothing to make this spectrum available for AMS, the rest of the world will not stand still. AMS will still become a reality, because competitor groups in other countries will assuredly step in to fill the void - and are already taking steps to do just that. Commercial and regulatory entities in other countries are making efforts to encourage the development of paging technology in order to offer advantages to home suppliers. The ERMES Pan-European paging system is expected to begin limited service by the beginning of 1993 in numerous EEC and ETSI countries using a simulcast protocol of over 6,000 BPS in spectrum recently allocated to paging. Japanese companies are currently conducting experiments with one-way data FAX service.

The U.S. paging industry must be allowed access to all possible tools to remain in an aggressive leadership position in the paging technology race. The key missing tool for Advanced Messaging Service is spectrum. The 930-931 MHz band which was so wisely set aside by the Commission in 1982 is now urgently needed to serve its original purpose.

VI. SHARING OF THE 930-931 MHz BAND WITH LOW EARTH ORBIT SATELLITE LINKS PRESENTS SIGNIFICANT OPERATIONAL PROBLEMS WHICH MUST BE CLEARLY UNDERSTOOD.

The issue of interference to advanced paging systems operation by LEO link operation in the 930-931 MHz band has been previously addressed. For example, in its Reply Comments to the Commission's Second Notice of Inquiry in the Mobile WARC proceeding, Motorola presented an analysis demonstrating that unacceptable interference to such paging systems would occur, even if such LEO operations took place on a secondary basis. That analysis is restated briefly at this point.

Assuming that advanced paging system receivers employ a bit rate similar to that of the LEO downlink, the basic sensitivity of the advanced paging receivers and the satellite downlink receiver will be similar. It is reasonable to expect the satellite receiver-antenna combination to require only about 3 dB less signal for operation than the pager receiver-antenna combination (paging antennas at 930 MHz are quite efficient). The LEO system would be expected to be designed for about 3 dB margin at the worst regularly usable satellite position and to have at least 5 dB more signal level when the satellite is in its optimal position. At this optimal position, the interference level from the LEO system would be at approximately 8 dB above the minimum level required for interference to a paging receiver at street level (assuming a 3 dB capture in the paging receiver).

This interference level would suggest a need for 8 dB of additional transmitter power to the paging receiver to guarantee reception. This translates into a real world necessity to re-design advanced paging system networks by installing a far greater number of simulcast transmitters, not out of any need on the part of paging users, but simply to overcome this serious interference situation caused by LEO operations in the same band. Furthermore, if it were not possible in certain areas to increase transmitter power as described, a 90% on-the-street coverage area would drop to as low as 50% coverage. Neither of these alternatives is acceptable, both in terms of costs to the user and degradation of quality of signal penetration.

The interference situation described above remains unchanged by the Third Interim Report of Ad Hoc Group A of IWG-2, dated Feb. 14, 1991. The latter report submitted certain modifications purporting to alleviate interference concerns by demonstrating a method of sharing. In reality, the report's described method of sharing essentially consists of not operating the satellite on an occupied fixed or mobile channel. In principle, this method would appear to cause no interference, because LEO operations would not take place where advanced paging was using a particular portion of spectrum. The practical reality, however, is another situation.

It will prove to be difficult, perhaps impossible, for LEOs and advanced paging systems to "avoid" each other as described in the Third Interim Report. Due to the high orbital speeds of the LEOs (on the order of 16,000 miles per hour) doppler shifts will occur, having a magnitude on the order of one channel width (approximately 20-23 KHz at 930 MHz) on approach and one channel width in the other direction, as "seen" on the earth. It will thus not be sufficient for satellites simply to avoid the fixed or mobile channel which is being used by an advanced paging system: the satellite must also avoid more than a single 25 kHz channel. Otherwise, the doppler shift will create the same interference problem as if the satellite were in fact operating on the frequency currently in use by the terrestrial system. The number of channels which would thus be "out of bounds" for LEO operation would be increasingly diminished as more channels are used by developing advanced paging systems.

The interference situation described above will not be an isolated or localized phenomenon; instead, it will blanket the entire United States. This is because LEO satellites, which use non-directionalized antennas, will have an area of coverage of thousand of miles in diameter. In order to avoid a nationwide occurrence of such interference, it will be necessary for the LEO satellites to avoid essentially all fixed or mobile channels, as well as to preserve a guard band around each such channel. Otherwise, the doppler shift form of interference described above will be caused throughout the country. The sharing proposal offered in the Third Interim Report simply will not work in practice.

It should also be noted that LEO ground receivers would similarly receive interference from fixed stations of advanced paging systems. These fixed stations are also expected to employ

non-directionalized antennas, which would transmit a signal expected to be many dB above the threshold of LEO satellite ground receivers.

VII. THE COMMISSION SHOULD ADOPT A POLICY OF REGULATORY FLEXIBILITY IN TERMS OF THE DETAILS OF SYSTEM OPERATION IN THIS BAND.

As Telocator pointed out in its Petition, the choice of services and the methods of operation of AMS should be the choice of the service provider. Minimal requirements should be adopted as to technical parameters to ensure that the services offered are ones which predominantly utilize advanced messaging system technology. For example, bit rates could be set at the level of at least 4800 BPS, or voice compression rates could be specified to be at least 8. This approach is consistent with a number of recent Commission actions which have correctly chosen regulatory flexibility in order to allow advanced technologies and services to develop robustly, in lieu of adopting detailed government standards which run the risk of quickly becoming obsolete.

CONCLUSION

The time is now appropriate, indeed it is urgently needed for the Commission to move forward to make the 930-931 MHz band available for use for an Advanced Messaging Service. The public's acceptance of and increased demand for paging services are rapidly transitioning into the demand to embrace advanced messaging technologies to meet today's and tomorrow's one-way messaging needs. A hallmark of the success of the paging service has been that it remains the lowest-cost alternative form of messaging service. It is essential to retain this aspect for emerging AMS by making this key portion of spectrum available for the launch of these important services.

It is also vital to the nation's interest that the challenge of the emerging AMS services be met by this country if we are to retain our leadership in paging technology. If we fail to recognize and seize this opportunity, other nations will surely come forward to capitalize on similar AMS initiatives which are already underway within their own borders. The spectrum

should be made available expeditiously and without unrealistic sharing criteria which will compromise its viability.

CERTIFICATE OF SERVICE

I, Alice M. de Séve, a secretary with Motorola Inc., do hereby certify that on this 11th day of March, 1991 a copy of the foregoing "Comments" was sent to each of the following by first-class mail, postage-prepaid except where service by hand is indicated(*):

Alice M. de Séve

*Donna R. Searcy, Secretary
Office of Managing Director
Federal Communications Commission
Room 222
1919 M Street, N.W.
Washington, DC 20554

Thomas Stroup
President
Telocator
2000 M Street, N.W., Suite 230
Washington, DC 20036

Michael Senkowski, Esq.
Wiley, Rein & Fielding
1776 K Street
Washington , DC 20006

Jack Richards, Esq.
Keller and Heckman
1150 - 17th Street, N.W., Suite 1000
Washington, DC 20036

Jay Kitchen
President
NABER
1501 Duke Street, Suite 200
Alexandria, VA 22313